Keysight 855xxA/B Series CalPods and 85523B CalPod Controller

85530B 20 GHz CalPod (Standard)
85531B 20 GHz CalPod (Temperature Characterized)
85532B 20 GHz CalPod (Thermal-Vacuum Environment)
85540A/B 40 GHz CalPod (Standard)
85541A/B 40 GHz CalPod (Temperature Characterized)
85542A/B 40 GHz CalPod (Thermal-Vacuum Environment)
85523B CalPod Controller

NOTICE: This document contains references to Agilent Technologies. Agilent's former Test and Measurement business has become Keysight Technologies. For more information, go to www.keysight.com.

Performance Characteristics

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Keysight 855xxA/B Series CalPods and 85523B CalPod Controller

Definitions

Typical

Describes additional product performance information that is not covered by the product warranty. It is performance that 80% of the units exhibit with a 95% confidence level over the temperature range 20 to 30 °C. Typical performance does not include measurement uncertainty.

Supplemental Characteristics

Describes Typical, but non-warrantied performance parameters, denoted as “Typical,” “Nominal,” or “Approximate.”

Typical Performance for 20 GHz CalPods

Keysight 85530B 20 GHz CalPod (Standard)
Keysight 85531B 20 GHz CalPod (Temperature Characterized)
Keysight 85532B 20 GHz CalPod (Thermal-Vacuum Environments)

Frequency of Operation 100 MHz to 20 GHz

Table 1 Maximum Insertion Loss

Frequency	Insertion Loss (dB)
100 MHz to 10 GHz	3.5
10 to 20 GHz	4.0

Table 2 Minimum Return Loss at RF2 Output Port

Frequency	Return Loss (dB)
100 MHz to 5 GHz	12.0
5 to 20 GHz	9.0

Table 3 Corrected Performance Repeatability for Transmission Measurements[1, 2]

Frequency	Amplitude (S21 and S12, dB)	Phase (S21 and S12, degrees)
100 to 750 MHz	±0.10	±1.5
750 MHz to 18 GHz	±0.05	±1.5
18 to 20 GHz	±0.20	±2.0

1. Measured at 25 °C with a 3 dB loss between the PNA test port and the CalPod, with 1 kHz IF BW, –5 dBm power level, and eight averages.
2. The transmission measurement uncertainty is for a single CalPod. When two CalPods are used together with a 2-port DUT, the total measurement uncertainty is twice this value.

Table 4 Corrected Performance Repeatability for Reflection Measurements[1]

Frequency	Residual Directivity (dB)[2]
100 to 750 MHz	–32
750 MHz to 18 GHz	–38
18 to 20 GHz	–32

1. Measured at 25 °C with a 3 dB loss between the PNA test port and the CalPod, with 1 kHz IF BW, –5 dBm power level, and eight averages.
2. Residual directivity = 20 Log10 (S11n –S11ref), where S11n is the nth recorrection, and S11ref is the initial S11 measurement.

Residual Recorrection Errors of S21 and S12 Magnitude Versus Attenuation - 85530B/1B/2B

As the test port cable loss between the PNA and the CalPod increases, the residual S21 recorrection error tends to increase. This increase in the residual error is due to signal-to-noise degradation of the measurements of the CalPod reflection standards with increasing cable loss. The following graphs and tables provide guidance on the CalPod recorrection residual error that can be expected versus cable attenuation. Note that the cable attenuation is one-way attenuation from one of the PNA test ports to the CalPod. To reduce the effects of signal-to-noise degradation of the measurements of the CalPod reflection standards, the (open, short, load) OSL averaging feature in the CalPod firmware dialog box can be used. This will measure the reflection standards multiple times (as specified by the user), and average the value, to reduce the effects of signal-to-noise effects on measuring the reflection standards.

NOTE The values in the following tables and graphs use no OSL averaging.

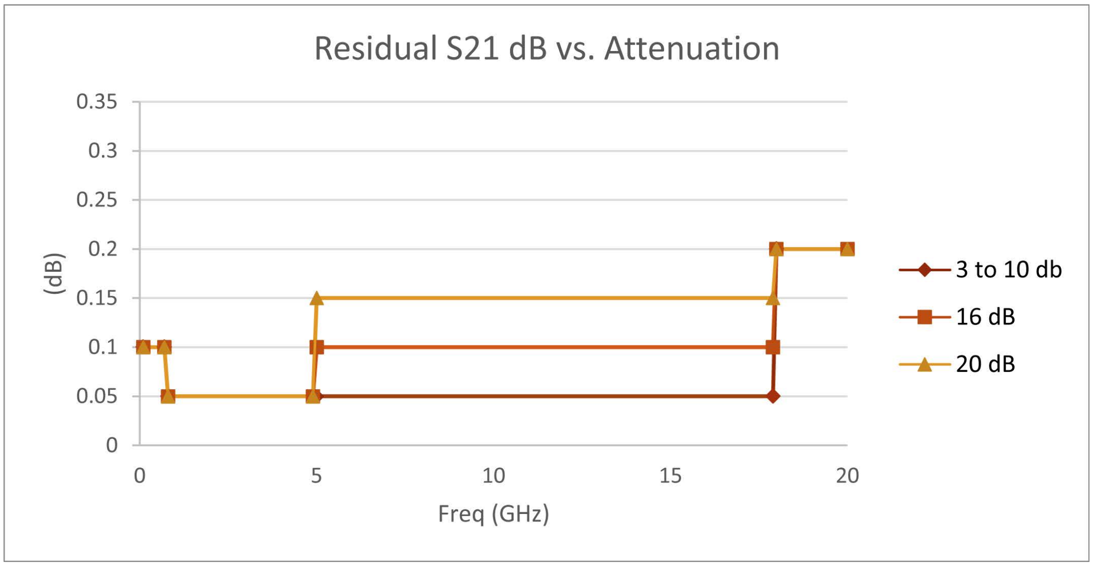


Table 5 Residual Recorrection Errors of S21 and S12 Magnitude Versus Attenuation - 85530B/1B/2B

Frequency	Residual Errors Versus Attenuation (dB)		
	3 to 10 dB	16 dB	20 dB
100 to 700 MHz	±0.10	±0.10	±0.10
800 MHz to 5 GHz	±0.05	±0.05	±0.05
5 to 18 GHz	±0.05	±0.10	±0.15
18 to 20 GHz	±0.20	±0.20	±0.20

Residual Recorrection Errors of S21 and S12 Phase Versus Attenuation - 85530B/1B/2B

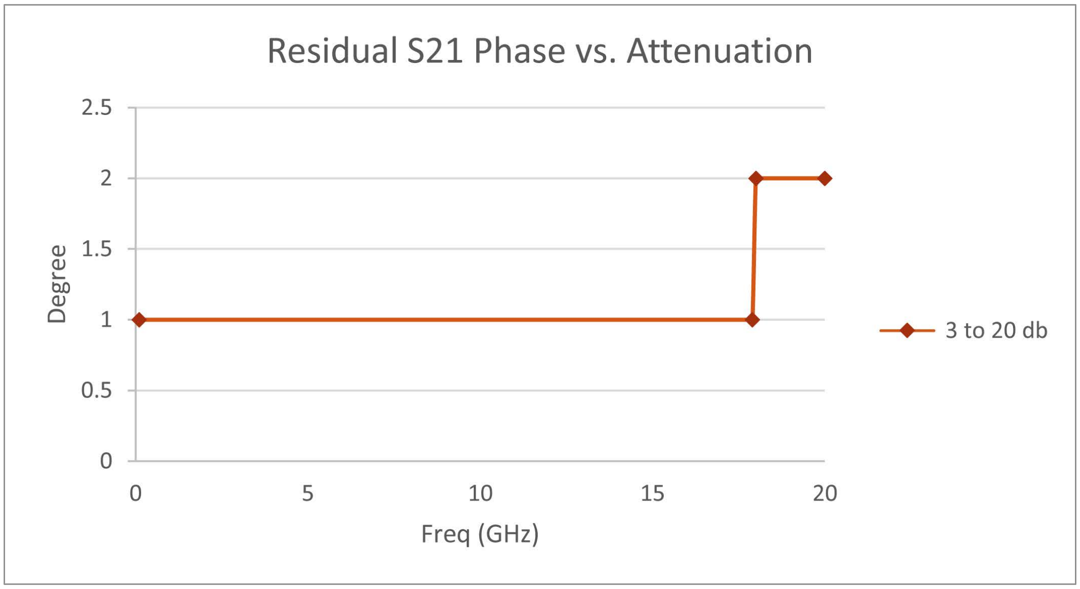


Table 6 Residual Recorrection Errors of S21 and S12 Phase Versus Attenuation - 85530B/1B/2B

Frequency	Residual Errors Versus Attenuation (degrees)		
	3 to 10 dB	16 dB	20 dB
100 MHz to 18 GHz	1	1	1
18 to 20 GHz	2	2	2

Residual Recorrection Directivity Errors for S11 and S22 Magnitude Versus Attenuation - 85530B/1B/2B

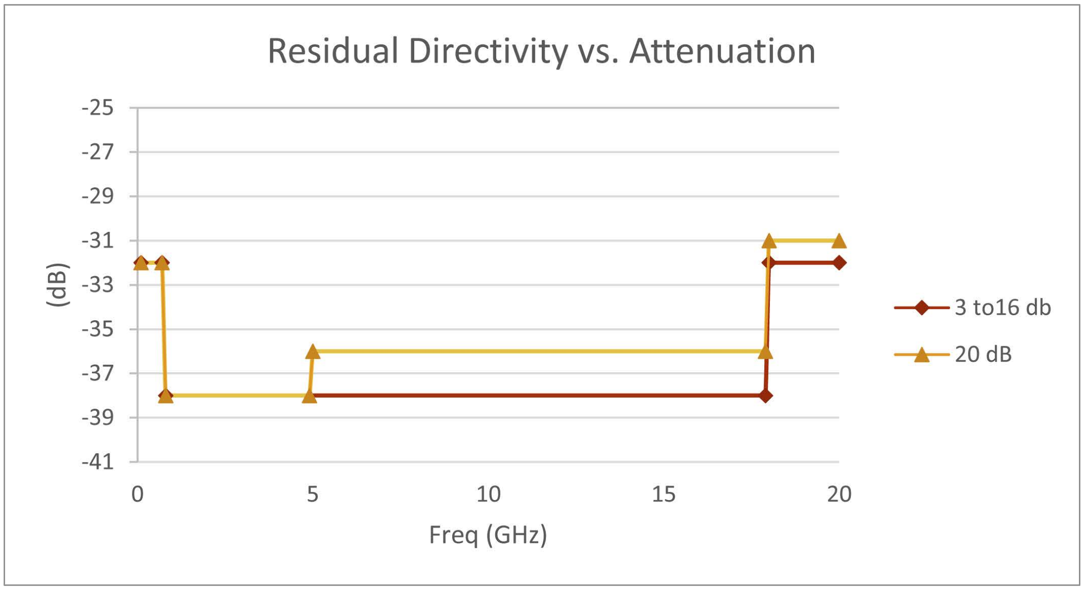


Table 7 Residual Recorrection Errors of S11 and S22 Magnitude Versus Attenuation - 85530B/1B/2B

Frequency	Residual Directivity Errors Versus Attenuation (dB)		
	3 to 10 dB	16 dB	20 dB
100 to 700 MHz	–32	–32	–32
800 MHz to 5 GHz	–38	–38	–38
5 to 18 GHz	–38	–38	–36
18 to 20 GHz	–32	–32	–31

Residual Recorrection Errors of S21 and S12 Magnitude Versus Temperature Change - 85531B/2B

Refer to "Temperature Change and Temperature Hysteresis Effects" on page 27 for an explanation of how these temperature errors affect the overall measurement uncertainty.

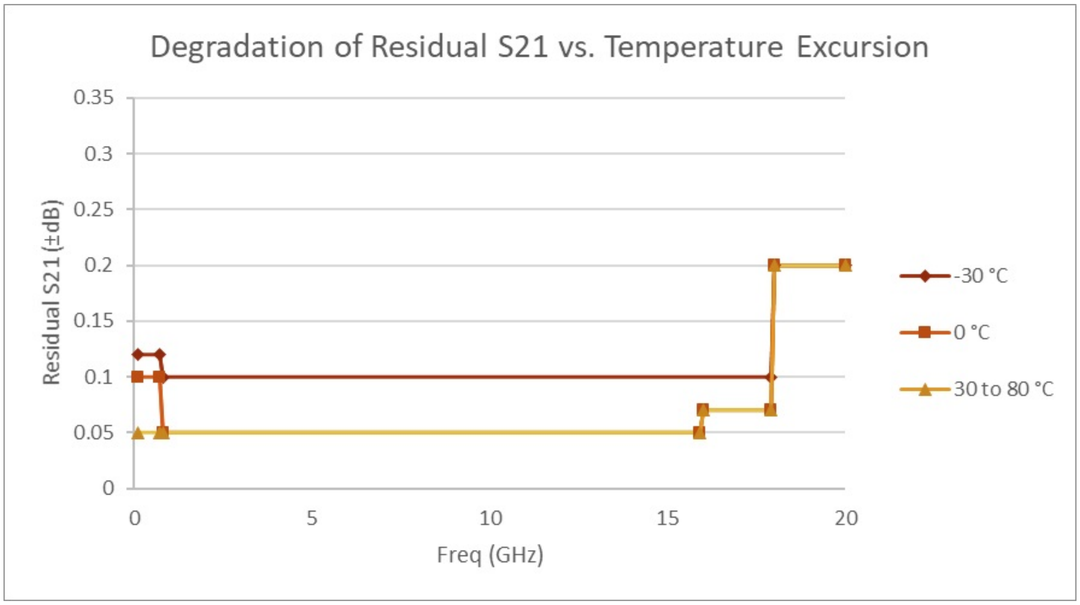


Table 8 Residual Recorrection Errors Versus Temperature Change

Frequency	Residual Errors Versus Temperature Change (dB)				
	–30 °C	0 °C	30 °C	50 °C	80 °C
100 to 750 MHz	±0.12	±0.10	±0.05	±0.05	±0.05
750 MHz to 16 GHz	±0.10	±0.05	±0.05	±0.05	±0.05
16 to 18 GHz	±0.10	±0.07	±0.07	±0.07	±0.07
18 to 20 GHz	±0.20	±0.20	±0.20	±0.20	±0.20

Residual Recorrection Errors of S11 and S22 Magnitude Versus Temperature Change - 85531B/2B

Refer to “Temperature Change and Temperature Hysteresis Effects” on page 27 for an explanation of how these temperature errors affect the overall measurement uncertainty.

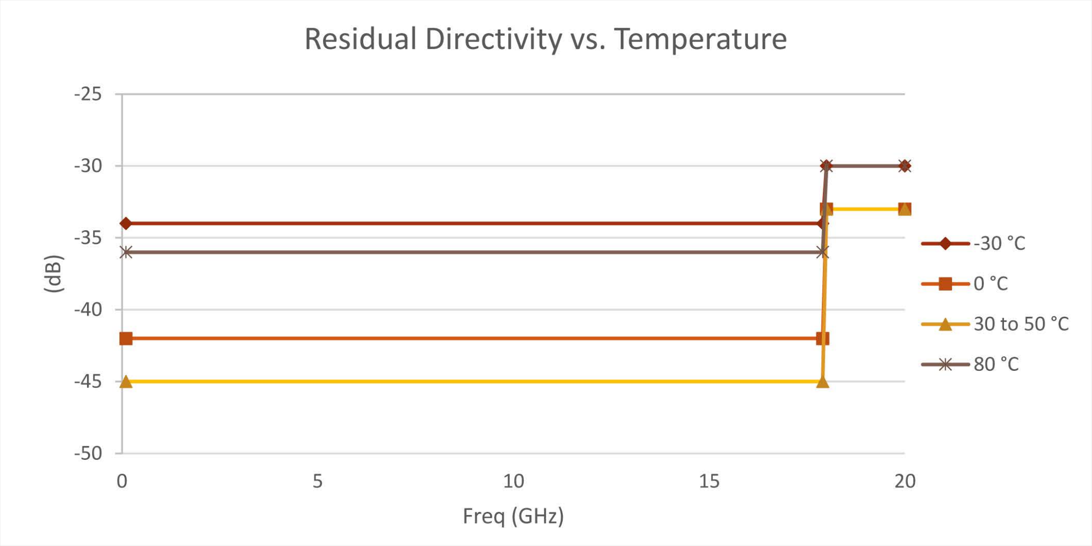


Table 9 Residual Recorrection Directivity Errors Versus Temperature Change

	Residual Errors Versus Temperature Change (dB)				
Frequency	–30 °C	0 °C	30 °C	50 °C	80 °C
100 to 750 MHz	-34	-42	-45	-45	-36
750 MHz to 18 GHz	-34	-42	-45	-45	-36
18 to 20 GHz	-30	-33	-33	-33	-30

Typical Performance for 40 GHz CalPods

Keysight 85540A/B 40 GHz CalPod (Standard)
Keysight 85541A/B 40 GHz CalPod (Temperature Characterized)
Keysight 85542A/B 40 GHz CalPod (Thermal-Vacuum Environments)

Frequency of Operation 500 MHz to 40 GHz

Table 10 **Maximum Insertion Loss**

	Insertion Loss (dB)	
Frequency	85540A/1A/2A	85540B/1B/2B
500 to 750 MHz	4.6	6.4
750 MHz to 1 GHz	3.9	4.5
1 to 2 GHz	3.6	3.9
2 to 18 GHz	3.5	3.5
18 to 20 GHz	3.7	3.6
20 to 34 GHz	5.5	6.2
34 to 36 GHz	7.0	6.2
36 to 40 GHz	7.2	6.8

Table 11 **Minimum Return Loss at RF2 Output Port**

	Return Loss (dB)	
Frequency	85540A/1A/2A	85540B/1B/2B
500 to 750 MHz	8.0	8.0
750 MHz to 1 GHz	11.0	11.0
1 to 20 GHz	12.0	12.0
20 to 33 GHz	9.5	9.5
33 to 40 GHz	6.5	6.5

Table 12 Corrected Performance Repeatability for Transmission Measurements[1, 2]

Frequency	85540A/1A/2A		85540B/1B/2B	
	Amplitude (S21 & S12, dB)	Phase (S21 & S12, degrees)	Amplitude (S21 & S12, dB)	Phase (S21 & S12, degrees)
500 to 750 MHz	±0.10	±1.5	±0.10	±1.5
750 MHz to 18 GHz	±0.05	±1.5	±0.05	±1.5
18 to 23 GHz	±0.20	±2.0	±0.10	±1.5
23 to 33 GHz	±0.10	±1.5	±0.10	±1.5
33 to 40 GHz	±0.20	±2.0	±0.20	±2.0

1. Measured at 25 °C with a 3 dB loss between the PNA test port and the CalPod, with 1 kHz IF BW, –5 dBm power level, and eight averages.
2. The transmission measurement uncertainty is for a single CalPod. When two CalPods are used together with a 2-port DUT, the total measurement uncertainty is twice this value.

Table 13 Corrected Performance Repeatability for Reflection Measurements[1]

Frequency	85540A/1A/2A	85540B/1B/2B
	Residual Directivity (dB)[2]	Residual Directivity (dB)[2]
500 MHz to 750 MHz	-32	-32
750 MHz to 18 GHz	-38	-38
18 to 23 GHz	-32	-34
23 to 33 GHz	-34	-34
33 to 40 GHz	-32	-32

1. Measured at 25 °C with a 3 dB loss between the PNA test port and the CalPod, with 1 kHz IF BW, -5 dBm power level, and eight averages.
2. Residual directivity = 20 Log10 (S11n – S11ref), where S11n is the nth recorrection, and S11ref is the initial S11 measurement.

Residual Recorrection Errors of S21 and S12 Magnitude Versus Attenuation - 85540A/1A/2A

As the test port cable loss between the PNA and the CalPod increases, the residual S21 recorrection error tends to increase. This increase in the residual error is due to signal-to-noise degradation of the measurements of the CalPod reflection standards with increasing cable loss. The following graphs and tables provide guidance on the CalPod recorrection residual error that can be expected versus cable attenuation. Note that the cable attenuation is one-way attenuation from one of the PNA test ports to the CalPod. To reduce the effects of signal-to-noise degradation of the measurements of the CalPod reflection standards, the (open, short, load) OSL averaging feature in the CalPod firmware dialog box can be used. This will measure the reflection standards multiple times (as specified by the user), and average the value, to reduce the effects of signal-to-noise effects on measuring the reflection standards.

NOTE **The values in the following tables and graphs use no OSL averaging. Values are based on two CalPods setup with a thru circuit.**

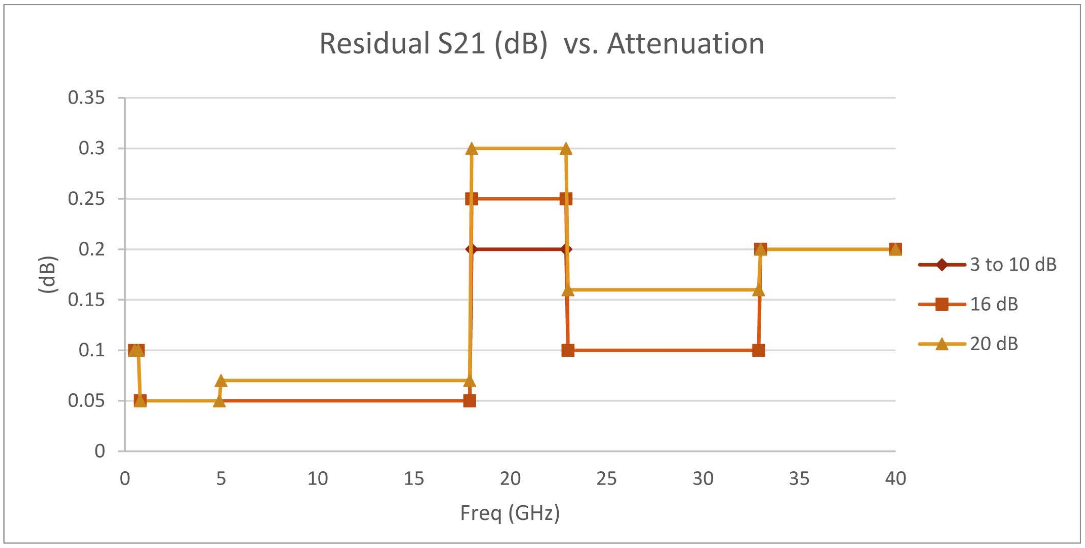


Table 14 Residual Recorrection Errors of S21 and S12 Magnitude Versus Attenuation - 85540A/1A/2A

	Residual Errors Versus Attenuation (dB)		
Frequency	3 to 10 dB	16 dB	20 dB
500 to 700 MHz	±0.10	±0.10	±0.10
800 MHz to 5 GHz	±0.05	±0.05	±0.05
5 to 18 GHz	±0.05	±0.05	±0.07
18 to 23 GHz	±0.20	±0.25	±0.30
23 to 33 GHz	±0.10	±0.10	±0.16
33 to 40 GHz	±0.20	±0.20	±0.20

Residual Recorrection Errors of S21 and S12 Magnitude Versus Attenuation - 85540B/1B/2B

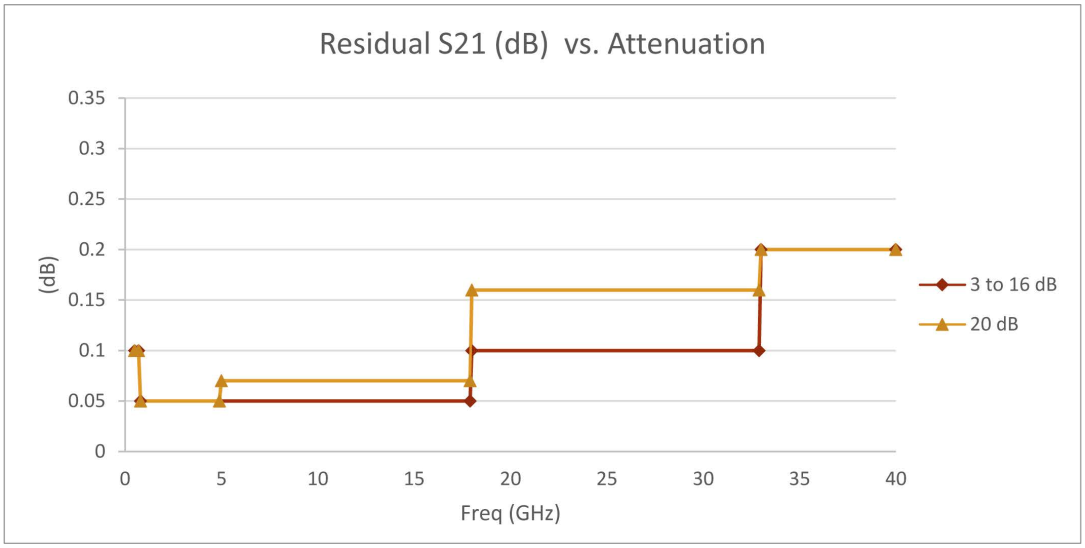


Table 15 Residual Recorrection Errors of S21 and S12 Magnitude Versus Attenuation - 85540B/1B/2B

Frequency	Residual Errors Versus Attenuation (dB)		
	3 to 10 dB	16 dB	20 dB
500 to 700 MHz	±0.10	±0.10	±0.10
800 MHz to 5 GHz	±0.05	±0.05	±0.05
5 to 18 GHz	±0.05	±0.05	±0.07
18 to 33 GHz	±0.10	±0.10	±0.16
33 to 40 GHz	±0.20	±0.20	±0.20

Residual Recorrection Errors of S21 and S12 Phase Versus Attenuation - 85540A/1A/2A

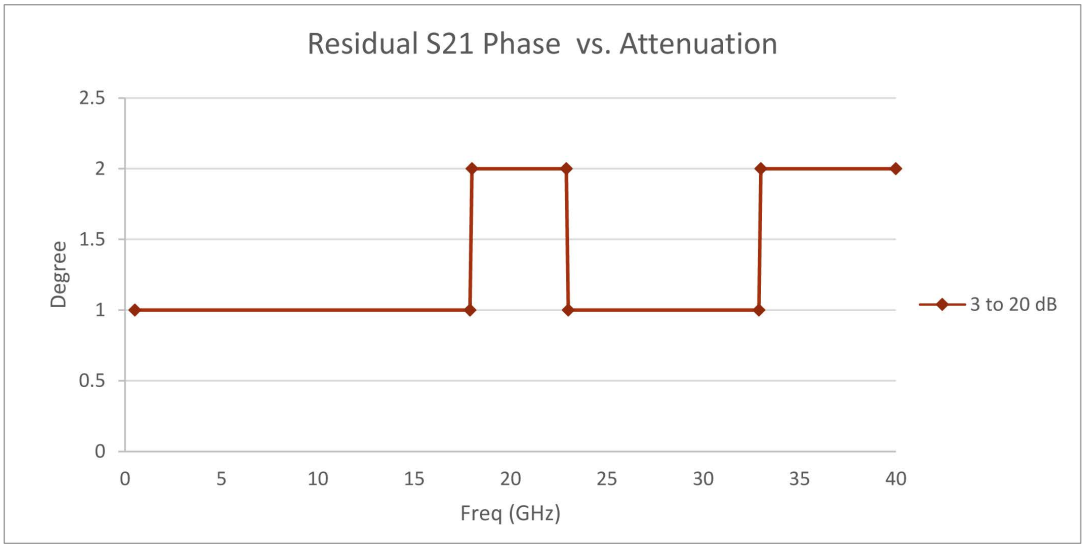


Table 16 Residual Recorrection Errors of S21 and S12 Phase Versus Attenuation - 85540A/1A/2A

	Residual Errors Versus Attenuation (degrees)		
Frequency	3 to 10 dB	16 dB	20 dB
500 MHZ to 18 GHz	1	1	1
18 to 23 GHz	2	2	2
23 to 33 GHz	1	1	1
33 to 40 GHz	2	2	2

Residual Recorrection Errors of S21 and S12 Phase Versus Attenuation - 85540B/1B/2B

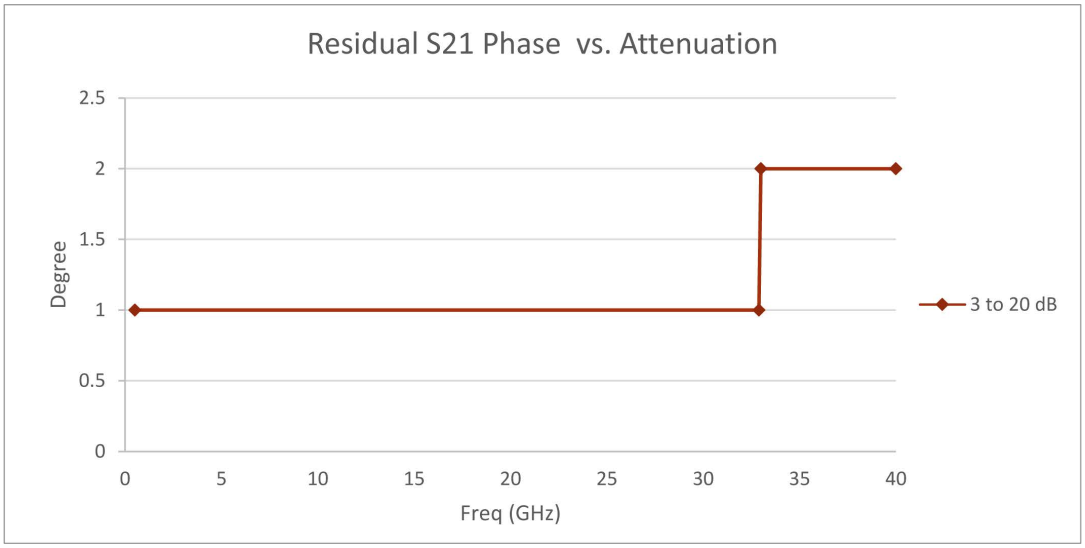


Table 17 Residual Recorrection Errors of S21 and S12 Phase Versus Attenuation - 85540B/1B/2B

Frequency	Residual Errors Versus Attenuation (degrees)		
	3 to 10 dB	16 dB	20 dB
500 MHZ to 18 GHz	1	1	1
18 to 33 GHz	1	1	1
33 to 40 GHz	2	2	2

Residual Recorrection Errors of S11 and S22 Magnitude Versus Attenuation - 85540A/1A/2A

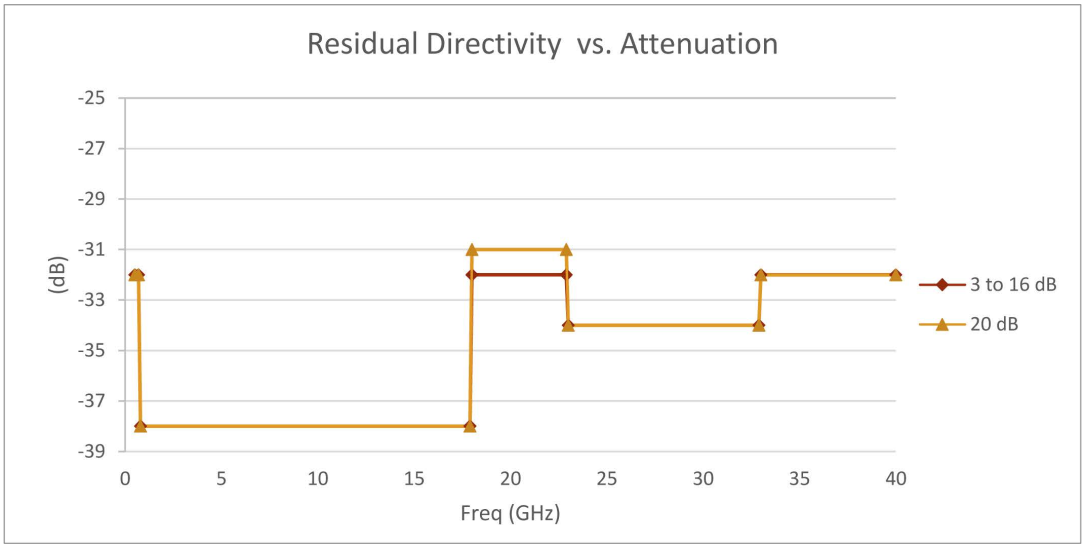


Table 18 Residual Recorrection Errors of S11 and S22 Magnitude Versus Attenuation - 85540A/1A/2A

Frequency	Residual Directivity Errors Versus Attenuation (dB)		
	3 to 10 dB	16 dB	20 dB
500 to 700 MHz	-32	-32	-32
700 MHz to 18 GHz	-38	-38	-38
18 to 23 GHz	-32	-32	-31
23 to 33 GHz	-34	-34	-34
33 to 40 GHz	-32	-32	-32

Residual Recorrection Errors of S11 and S22 Magnitude Versus Attenuation - 85540B/1B/2B

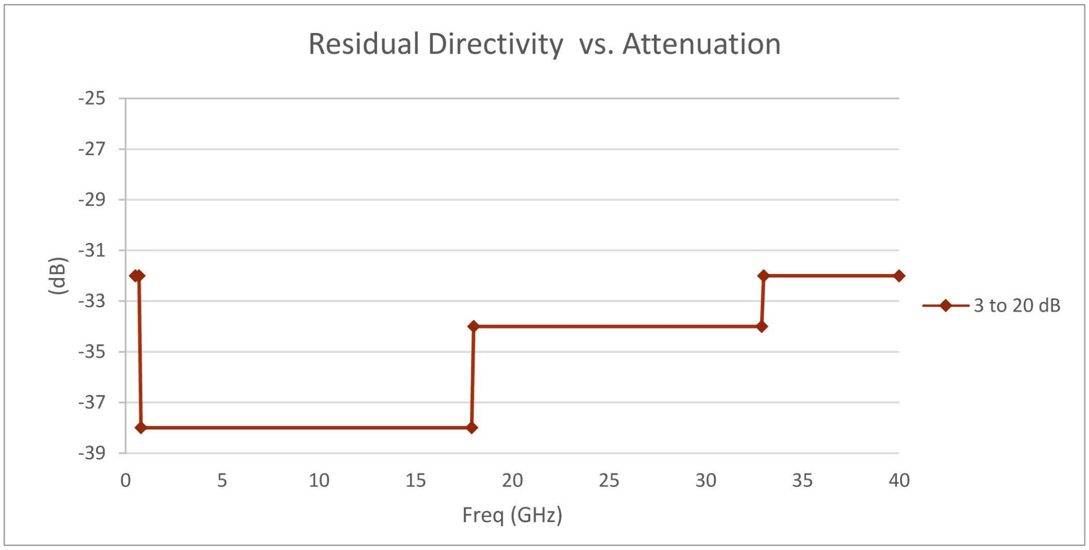


Table 19 Residual Recorrection Errors of S11 and S22 Magnitude Versus Attenuation - 85540B/1B/2B

Frequency	Residual Directivity Errors Versus Attenuation (dB)		
	3 to 10 dB	16 dB	20 dB
500 to 700 MHz	-32	-32	-32
700 MHz to 18 GHz	-38	-38	-38
18 to 33 GHz	-34	-34	-34
33 to 40 GHz	-32	-32	-32

Residual Recorrection Errors of S21 and S12 Magnitude Versus Temperature Change - 85541A/2A

Refer to "Temperature Change and Temperature Hysteresis Effects" on page 27 for an explanation of how these temperature errors affect the overall measurement uncertainty.

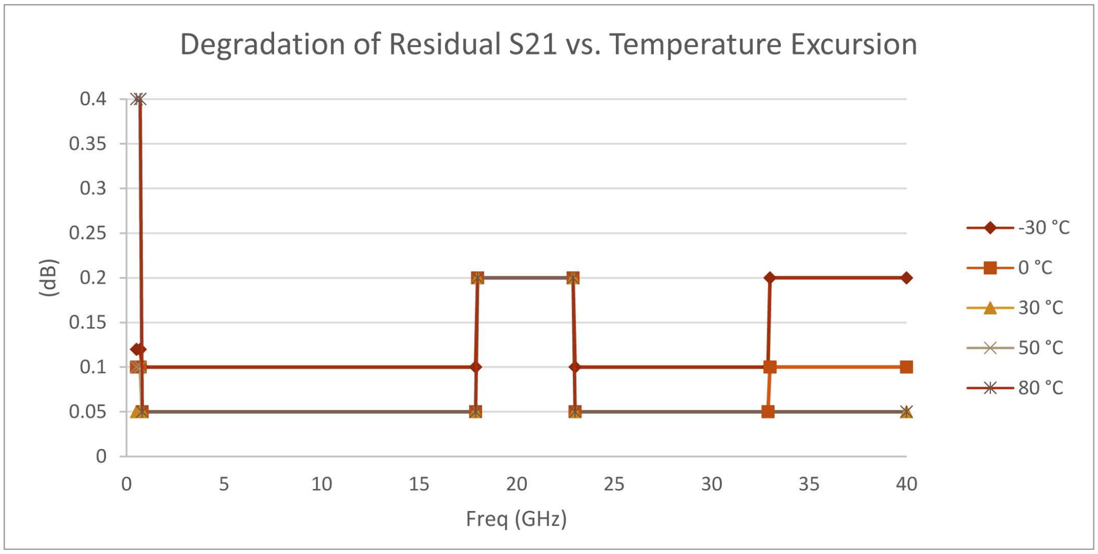


Table 20 Residual Recorrection Errors Versus Temperature Change

Frequency	Residual Errors Versus Temperature Change (dB)				
	−30 °C	0 °C	30 °C	50 °C	80 °C
500 to 750 MHz	±0.12	±0.10	±0.05	±0.10	±0.40
750 MHz to 18 GHz	±0.10	±0.05	±0.05	±0.05	±0.05
18 to 23 GHz	±0.20	±0.20	±0.20	±0.20	±0.20
23 to 33 GHz	±0.10	±0.05	±0.05	±0.05	±0.05
33 to 40 GHz	±0.20	±0.10	±0.05	±0.05	±0.05

Residual Recorrection Errors of S21 and S12 Magnitude Versus Temperature Change - 85541B/2B

Refer to "Temperature Change and Temperature Hysteresis Effects" on page 27 for an explanation of how these temperature errors affect the overall measurement uncertainty.

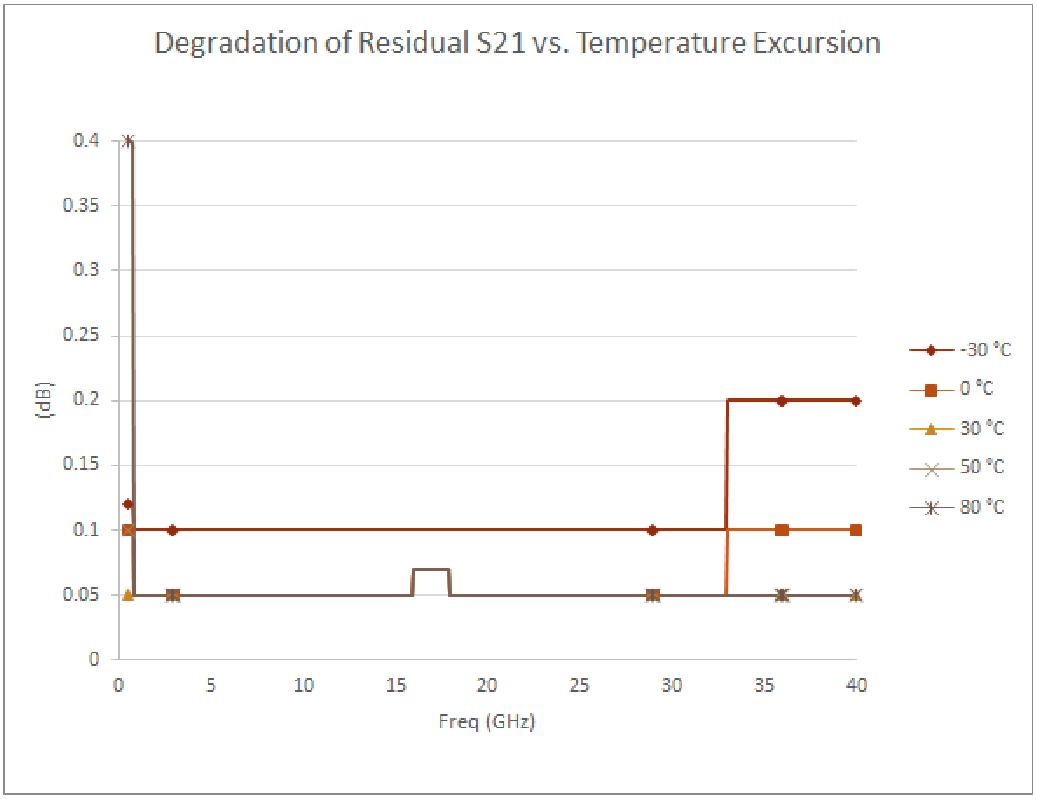


Table 21 Residual Recorrection Errors Versus Temperature Change

Frequency	Residual Errors Versus Temperature Change (dB)				
	–30 °C	0 °C	30 °C	50 °C	80 °C
500 to 750 MHz	±0.12	±0.10	±0.05	±0.10	±0.40
750 MHz to 16 GHz	±0.10	±0.05	±0.05	±0.05	±0.05
16 to 18 GHz	±0.10	±0.07	±0.07	±0.07	±0.07
18 to 33 GHz	±0.10	±0.05	±0.05	±0.05	±0.05
33 to 40 GHz	±0.20	±0.10	±0.05	±0.05	±0.05

Residual Recorrection Errors of S11 and S22 Magnitude Versus Temperature Change - 85541A/2A

Refer to “Temperature Change and Temperature Hysteresis Effects” on page 27 for an explanation of how these temperature errors affect the overall measurement uncertainty.

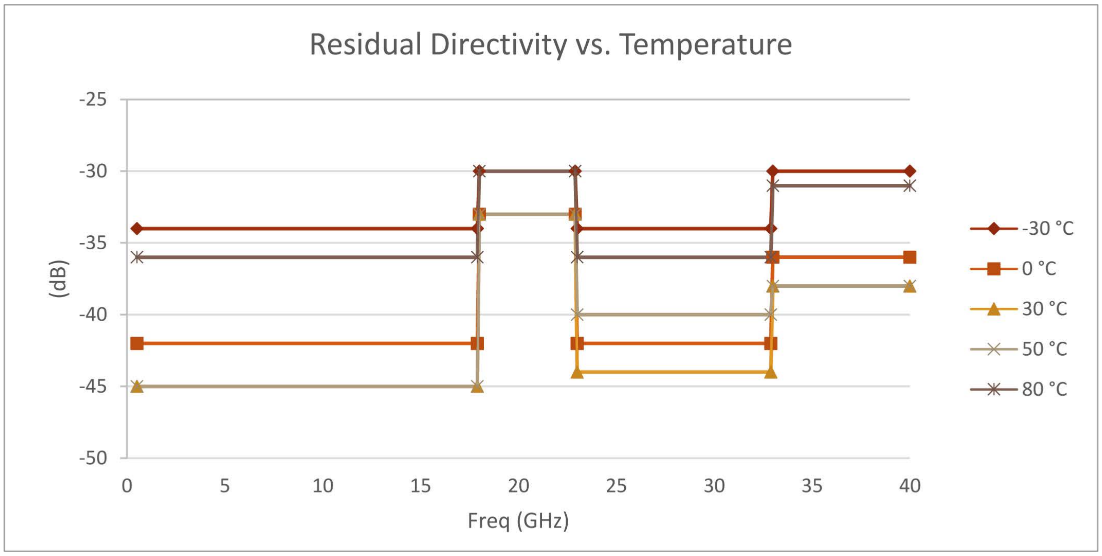


Table 22 Residual Recorrection Directivity Errors Versus Temperature Change

	Residual Errors Versus Temperature Change (dB)				
Frequency	−30 °C	0 °C	30 °C	50 °C	80 °C
500 to 750 MHz	-34	-42	-45	-45	-36
750 MHz to 18 GHz	-34	-42	-45	-45	-36
18 to 23 GHz	-30	-33	-33	-33	-30
23 to 33 GHz	-34	-42	-44	-40	-36
33 to 40 GHz	-30	-36	-38	-38	-31

Residual Recorrection Errors of S11 and S22 Magnitude Versus Temperature Change - 85541B/2B

Refer to “Temperature Change and Temperature Hysteresis Effects” on page 27 for an explanation of how these temperature errors affect the overall measurement uncertainty.

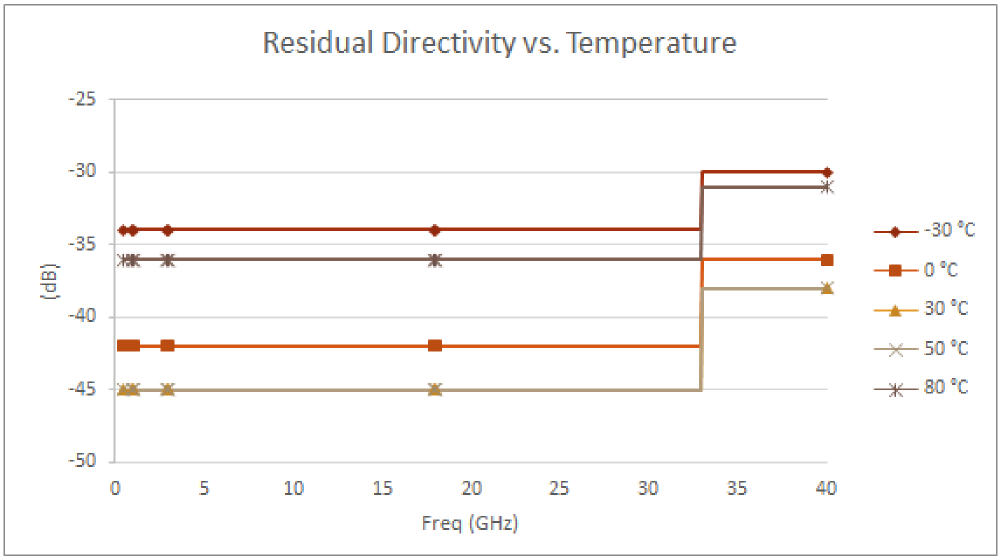


Table 23 Residual Recorrection Directivity Errors Versus Temperature Change

Frequency	Residual Errors Versus Temperature Change (dB)				
	−30 °C	0 °C	30 °C	50 °C	80 °C
500 to 750 MHz	-34	-42	-45	-45	-36
750 MHz to 18 GHz	-34	-42	-45	-45	-36
18 to 33 GHz	-34	-42	-45	-45	-36
33 to 40 GHz	-30	-36	-38	-38	-31

Supplemental Characteristics

Keysight 85530B 20 GHz CalPod (Standard)
Keysight 85531B 20 GHz CalPod (Temperature Characterized)
Keysight 85532B 20 GHz CalPod (Thermal-Vacuum Environments)

Keysight 85540A/B 40 GHz CalPod (Standard)
Keysight 85541A/B 40 GHz CalPod (Temperature Characterized)
Keysight 85542A/B 40 GHz CalPod (Thermal-Vacuum Environments)

Table 24 Supplemental Characteristics

Input 1 dB Compression point (> 1 GHz)	26 dB minimum
Input 3rd order intercept point (> 1 GHz)	+45 dBm minimum
Input level for 3rd order intercept point	2 tones @ +15 dBm maximum
Safe RF input level (damage limit)	+30 dBm minimum
Temperature (Standard CalPods)	
Operating	+25 °C ±5 °C
Storage	–40 °C to +90 °C
Temperature (Temperature characterized and thermal-vacuum environments CalPods)	
Operating[1]	–30 °C to +80 °C
Storage	–40 °C to +90 °C
Pressure	
For ambient and temperature compensated CalPods	Atmospheric pressure
For thermal-vacuum compatible CalPods	Atmospheric pressure to below 1 x 10^{-6} Torr
Dimensions	
Length x Width x Height, excluding connectors	2.8 in. x 1.2 in. x 0.6 in. (70 mm x 29 mm x 14 mm)
Weight	~ 100 grams
Connectors	
Input (RF1)	2.92 mm (male)
Output (RF2)	2.92 mm (female)
DC control signals	9-pin LEMO connector

1. Characterized data is based on CalPod internal measured temperature. If CalPod measured temperature is within specified limits, the characterized data is accurate and within specifications. Due to internal heating from CalPod components, there can be a delta between CalPod measured temperature and ambient chamber temperature.

CalPod Calibration Refresh Module Capabilities

The CalPod Calibration Refresh Modules are a new application of the ECal technology that provides an in-situ calibration refresh capability for the PNA family of vector network analyzers. There are many error sources that are present when making microwave measurements with a vector network analyzer. Systematic errors can be characterized and mathematically removed from the measurement by performing a user calibration, usually utilizing an electronic ECal calibration module. Other random errors such as switch and connector repeatability, variations due to cable movement, and thermal effects of cables, connectors, and adapters have been the bane of the microwave test engineer for decades. With CalPod Calibration Refresh Modules, many of these random errors can be eliminated from the measurement by performing periodic calibration refreshes.

The CalPods are used in-situ at the end of the test port cables, and located directly at the interface to the DUT. When desired, a CalPod calibration refresh can be performed, and a fresh valid calibration re-established at the DUT interface. This calibration refresh will remove the random errors due to the test cable movement or thermal effects, as well as connector and switch matrix repeatability.

Trade-offs of the CalPod Calibration Refresh Modules are the additional insertion loss of the CalPod modules, as well as the time required to perform a calibration refresh. The CalPods have the capability to do a source power calibration at the output of the CalPod module, so this can be used to set a power level at the input to the DUT. To do a calibration refresh, three sweeps in the forward direction, and three sweeps in the reverse direction need to be performed, to allow each of the CalPods to measure their three reflection standards. The amount of time to perform these six sweeps will depend upon the number of frequency points, the IF bandwidth of the receiver, and the amount of averaging being used in the measurement configuration. Typically these sweep times are quite small. Additionally, for greater recorrection accuracy, open, short, and load (OSL) averaging can be used to measure each of the reflection states multiple times, and then average the measured values to provide a more accurate measurement. The trade-off is that more sweeps need to be performed.

Applications for CalPods

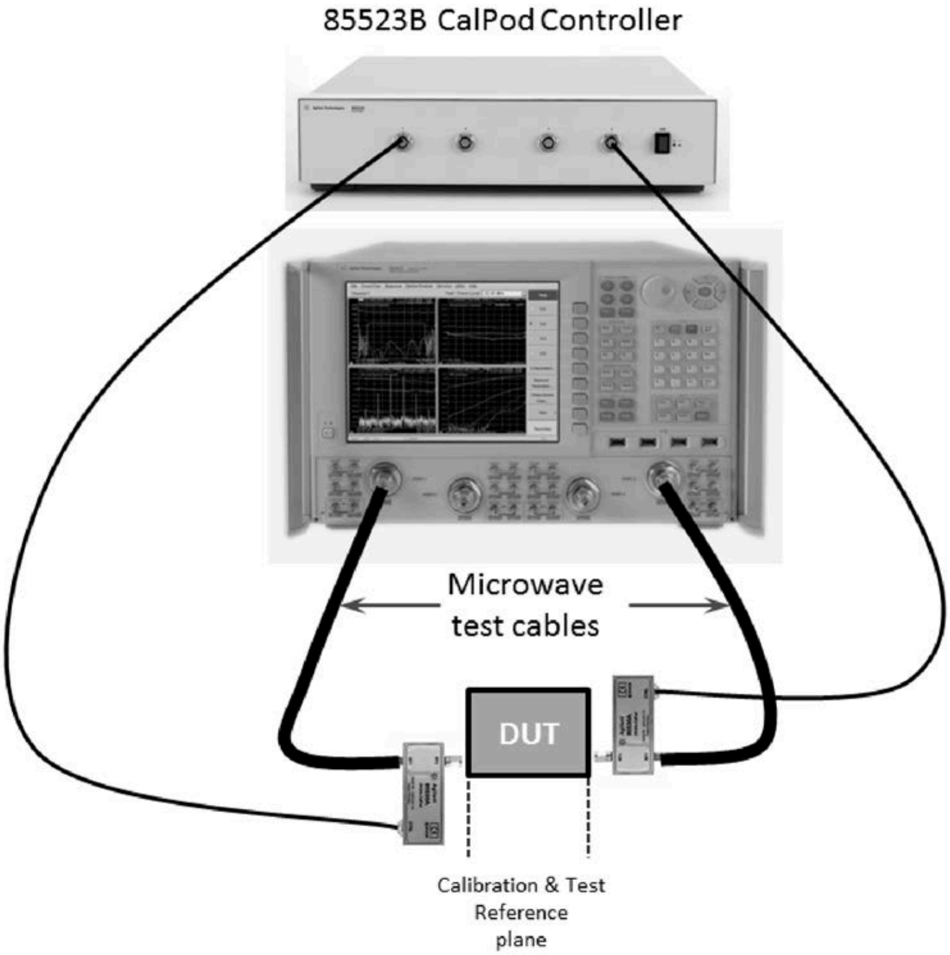
CalPods are useful in any measurement situation where it is desirable to have assurance that a valid calibration is present before recording measurement data. Some of the measurement applications where CalPods have proven useful are as follows:

- Thermal-vacuum testing
- Temperature chamber testing
- Measurement of low-loss devices
- Phase measurements requiring a high level of accuracy
- Applications that require frequent recalibrations
- Production test measurements for close device tolerances
- Applications requiring complex and lengthy calibrations, such as multi-port measurements
- Measurement of cables installed in aircraft
- Removal of switch matrix repeatability errors
- Removal of switch and connector repeatability errors in complex ATE systems

Measurement Uncertainty

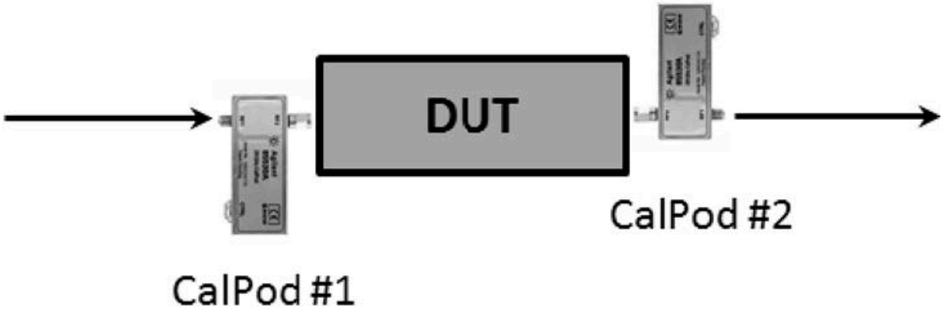
The information supplied in this CalPod Performance Characteristics document can be used to predict the typical recorrection values that can be obtained when using CalPod calibration refresh modules. Ideally one would want all calibration refresh operations to result in exactly the same value as the initial calibration, and exactly the same measurement value for the DUT. However, all microwave measurements are subject to small measurement uncertainties, and the CalPods also have small measurement uncertainties associated with their recorrections as well. This document explains how to determine the measurement uncertainty that can be expected with CalPods.

Figure 1 Typical 2-Port DUT Measurement with CalPods



The measurement uncertainty of a CalPod recorrection of a 2-port DUT can be determined by adding the recorrection residual S21 error of CalPod 1 and the recorrection residual S21 error of CalPod 2 together. The tables and graphs in this document provide values for the recorrection of residual S21 error versus frequency for the different models of CalPods.

Figure 2 Measurement Uncertainty of Both CalPods are Added Together for a 2-Port Measurement



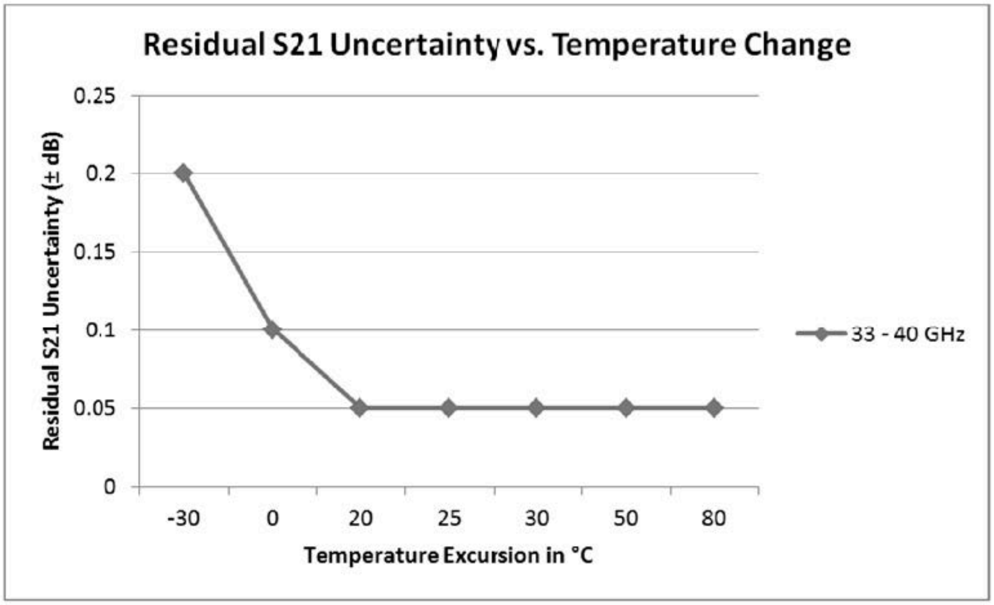
For an ambient temperature application, the measurement uncertainty of a CalPod recorrection is as follows:

Measurement uncertainty of a CalPod recorrection = **Recorrection residual S21 error for CalPod #1** + **Recorrection residual S21 error for CalPod #2**

Temperature Change and Temperature Hysteresis Effects

As the CalPods are subjected to wide temperature range variations, there is some measurement uncertainty that occurs due to the temperature change, and some uncertainty due to temperature hysteresis effects. The following graph provides an example of this effect, and provides information on how to interpret these temperature graphs in this document.

Figure 3 Example: Temperature Change Effects and Temperature Hysteresis Effects for 85540A/41A/42A CalPods



In this document there are graphs and tables of residual S21 uncertainties versus temperature changes. Figure 3 above serves as an example of how to interpret these graphs.

Temperature Change

As the CalPod temperature changes over wide ranges, there is some residual S21 uncertainty in the CalPod recorrection associated with a large temperature change. For example, let's assume that the CalPods are being used in a temperature chamber to measure DUT performance over a wide temperature range. As shown in Figure 3 above, if the CalPod is initialized at a room temperature of 25 °C, and then the temperature of the chamber containing the CalPod is decreased to 0 °C, the residual S21 measurement uncertainty due to this temperature change would be ±0.10 dB. If the temperature of the chamber containing the CalPod is decreased to –30 °C, the residual measurement uncertainty due to this temperature change would be ±0.20 dB.

Temperature Hysteresis

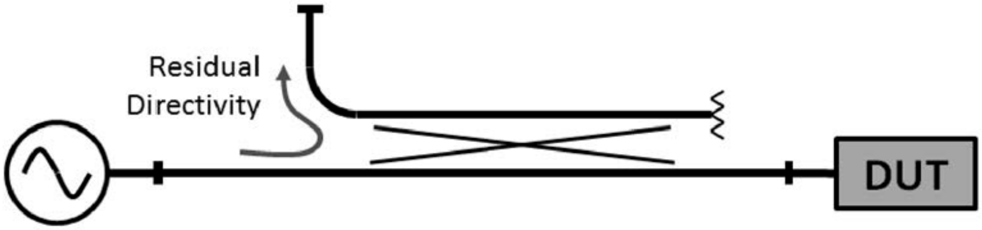
As the CalPod temperature changes from ambient room temperature to a widely different temperature, and then back to ambient room temperature, there can be a residual S21 measurement uncertainty due to a temperature hysteresis effect. For example, referring to Figure 3 above, if the CalPods are initialized at a room temperature of +25 °C, and the temperature of the chamber containing the CalPods is decreased to –30 °C, and then returned to +25 °C, the residual S21 measurement uncertainty due to a temperature hysteresis effect would be ±0.05 dB. Similarly, if initialized at +25 °C and then elevated to +25 °C and then returned to +25 °C, the measurement uncertainty due to a hysteresis effect would be ±0.05 dB. In an application where the temperature of the DUT and the CalPods see temperature excursions, the measurement uncertainty of a CalPod recorrection for a 2-port DUT is as follows:

Measurement uncertainty of a CalPod recorrection = **Recorrection residual S21 error for CalPod #1** + **Recorrection residual S21 error for CalPod #2** + **Temperature uncertainty effects of CalPod #1** + **Temperature uncertainty effects of CalPod #2**

Residual Directivity and 1-Port Measurements

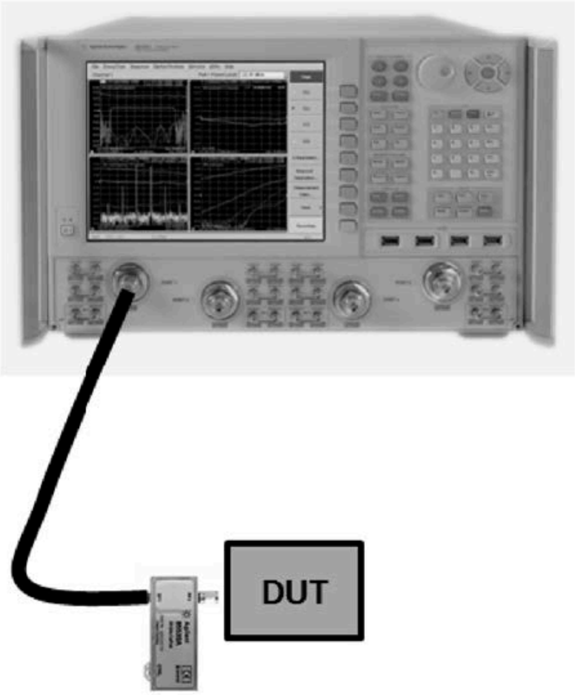
For measuring a 1-port device, there is a different way of specifying the measurement uncertainty of the recorrected measurement.

Figure 4 **Example of Residual Directivity**



For a 1-port DUT measurement, measured with one CalPod, we use the term “residual directivity” to define the measurement uncertainty of this 1-port recorrected measurement. The directivity of the coupler shown in Figure 4 limits the ability to resolve small reflection changes of the DUT. For example, if the return loss of the DUT shown in Figure 4 is –60 dB, and the directivity of the coupler is –32 dB, the measurement system used with this coupler can only resolve a reflection to –32 dB.

Figure 5 Reflection Measurement with a CalPod



When using a CalPod in a measurement system for a 1-port DUT, the residual directivity of the CalPod limits and defines the lowest reflection that can be resolved with the measurement system. Mathematically, the residual directivity can be defined as:

Residual directivity (dB) = 20 Log10 (S11n – S11ref)

Where:

S11ref is the initial S11 baseline or reference measurement
S11n is the nth S11 recorrection measurement

To calculate the measurement uncertainty of a recorrection of a 1-port device when using a CalPod, the following formula can be used to determine the measurement uncertainty due to the CalPod.

Measurement uncertainty of a CalPod recorrection = **Degradation of residual directivity for CalPod #1** + **Temperature uncertainty effects of CalPod #1**

Notices

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